

Roughness Discrimination Test Manual
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ROUGHNESS DISCRIMINATION TEST MANUAL

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The Roughness Discrimination Test (RDT) is an easily administered test of tactual ability. It was designed as a reading readiness test that would be more like a game than a test.

Learning to read represents a major goal for first grade pupils. Failure to attain this goal, in spite of attainment in other curricular areas, often leads to retention in grade. Success in learning to read depends, in part, upon pupils reaching certain levels of maturation in various abilities (Anderson & Dearborn, 1952). For example, a mental age of about 72 months has been held to be minimum for a student to learn to read under traditional methods of instruction.

Ability to discriminate stimuli that comprise the symbols for writing is another essential part of the reading process. This ability also is the result of growth and experience. Studies of visual reading have revealed that, in order to learn to read, a child must be able to make rather exact visual discriminations of the forms of letters and words (Tinker, 1952). This not only involves learning appropriate coordinated movements of the body and the visual receptors, but also an extensive knowledge of form.

It appears reasonable to assume that braille readers also must reach certain levels of maturation before learning to read is possible. In the past, the level of mental maturation has been believed to be identical to that of sighted readers and no evidence has accumulated to negate this assumption. The development of

ability to utilize the tactile receptors and hands in a coordinated fashion also appears critical to the braille reading process. The RDT was devised as a tool for measuring the development of this latter ability.

The RDT is composed of a set of cards upon each of which is mounted four pieces of sandpaper. Of these, three pieces are alike and one is different being rougher or coarser than the others. The task for the student taking the test is to find the piece of sandpaper that feels different from the others.

It is recommended that the RDT be given to students at the kindergarten or first grade level prior to any attempt to teach them braille. The test will serve to determine which students are able to make tactual discriminations and who, therefore, may be successful at learning braille. While tactual sensitivity is not the only factor relevant to the learning of braille, it is a critical one.

Directions for Administering the Roughness Discrimination Test

NOTE:

The RDT is composed of 69 items preceded by two sample items. Administration time is approximately 15-minutes. The test may be given by any sighted teacher.

Students who attempt to make choices visually should be blindfolded.

Instructions that are to be read aloud to the student are printed in capital letters. Instructions printed in small type are intended only for the examiner.

NOW I WANT YOU TO WORK SOME PUZZLES WITH ME.

Place the first sample card, Sample A, so that the label is at the subject's upper right and upside down, or, if the examiner is sitting opposite the subject, the label should be to the examiner's left and readable at the bottom of the card.

LOOK AT THE CARD IN FRONT OF YOU. FOUR PIECES OF PAPER ARE PASTED ON IT. CAN YOU FIND THE FOUR PIECES OF PAPER PASTED ON THE CARD?

(Wait while the subject inspects the card. If the child locates the papers correctly continue as below. If he is hesitant or unable to locate the papers, take his hand and lightly pass his fingertips over each square, saying: LET ME HELP YOU, HERE IS ONE PIECE, HERE IS THE SECOND, ETC.)

DID YOU NOTICE ANYTHING SPECIAL ABOUT THE PIECES OF PAPER ON THE CARD?

(If the child states that one piece of paper felt different or was rougher than the others, continue as follows.)

THAT'S RIGHT. ONE OF THE PIECES OF PAPER FEELS DIFFERENT FROM THE REST. THAT IS THE PUZZLE. LOOK AT EACH CARD AND TRY TO FIND THE PIECE OF PAPER THAT FEELS DIFFERENT FROM THE OTHER PIECES ON THE CARD. SOME OF THEM WILL BE EASY AND SOME WILL BE HARD. BE CAREFUL AND DO NOT LET ME FOOL YOU.

(Show Sample B in the same way as a check and if the child gives a correct response proceed with the rest of the items. All items should be presented to the subject with the label positioned as described for Sample A above. The position of the subject's response should be recorded on the Self-scoring Answer Sheet exactly.



For example, if the child picks the square nearest the label for the card, the examiner would mark the response option 1 one by the answer space having the same number as the test item.)

(Sometimes the child will not recognize differences among the pieces of sandpaper on the samples and these must be pointed out to him. Take his hand and brush his finger tips across the rougher square and then an adjacent square. Make similar comparisons with the other squares on the card. Verbal guidance should proceed as follows.)

LET ME SHOW YOU. LOOK AT THIS PIECE OF PAPER (rougher) AND THEN AT THIS PIECE. ARE THEY THE SAME? THIS PIECE IS ROUGHER OR SCRATCHIER THAN THIS. CAN YOU TELL THE DIFFERENCE? (continue comparison with other pieces) NOW FEEL THESE TWO. ARE THEY THE SAME? NO, ONE IS SCRATCHIER THAN THE OTHER, ETC.

(Now show the child Sample B. If he makes an immediate correct response, start the test. If he is hesitant or unsure of himself repeat Sample A and then B. However for this presentation rotate the cards 180 degrees so that their ends are reversed. By this time most children will understand the task and be able to proceed.) Then proceed as above.

Some children will not respond in such a way as to permit them to complete the test. These exceptions are as follow:

1. Failure to grasp the task. These subjects will not be able to detect the differences among squares in the Samples or to under-

stand what is desired of them. In this case, repeated examination of the Samples, reversing the ends on each repetition, will be necessary. If within five series of presentations of the Samples with appropriate explanation the subject still cannot make correct responses, testing should be terminated and the child assigned a zero score.

2. Adoption of a stereotyped response. Some children who can respond correctly to the samples fall into a stereotyped pattern of response within the first few items of the test. This usually happens because of their inability to make the finer tactual discriminations required by the test items; however emotional factors attendant to the testing situation may also play a part. This type of response usually consists of the child moving his hand rapidly across the card and consistently identifying the square at the end as different. However the response may become fixed at any position on the card.

In this case take a Sample card and rotate it so that the correct response is at least two squares removed from the fixated position. If the child responds correctly, display the other sample card and, if a correct response is given continue the test. This procedure should be followed if the subject gives four responses to the same position in sequence.

Testing is terminated if a subject adopts stereotyped responses five times within the test or if he is unable to give the correct responses to the samples when they are presented after he has adopted a stereotyped response. A zero score is then assigned.

3. Inability to focus attention on the task. Some children, be-

cause of immaturity, emotional disturbances, etc., will not be able to attend the task closely enough to complete it within a reasonable time. While the examiner should make every effort to hold the subject's attention and maintain high motivation, if, at the end of 10 minutes testing the child has not completed item 23, the test is terminated and a zero score assigned.

Directions for Scoring

A student's score on the RDT is his number of correct responses. The Self-scoring Answer Sheet is simple to score as the positions of the correct responses are underlined. Scoring is done by counting each student's correct responses.

Interpretation of Scores

Percentile ranks corresponding to raw scores are presented in Table 1. A percentile rank indicates the percentage of students having scores less than the given score in the normative group. With this information the value of a score can be determined. For example, a beginning first grade student might earn a score of 49 on the RDT. From Table 1 the corresponding percentile rank of 75 can be determined. This means that 75% of students at this grade level in the norm group made scores below 49 on the RDT during their first month (16 September-15 October) in the first grade.

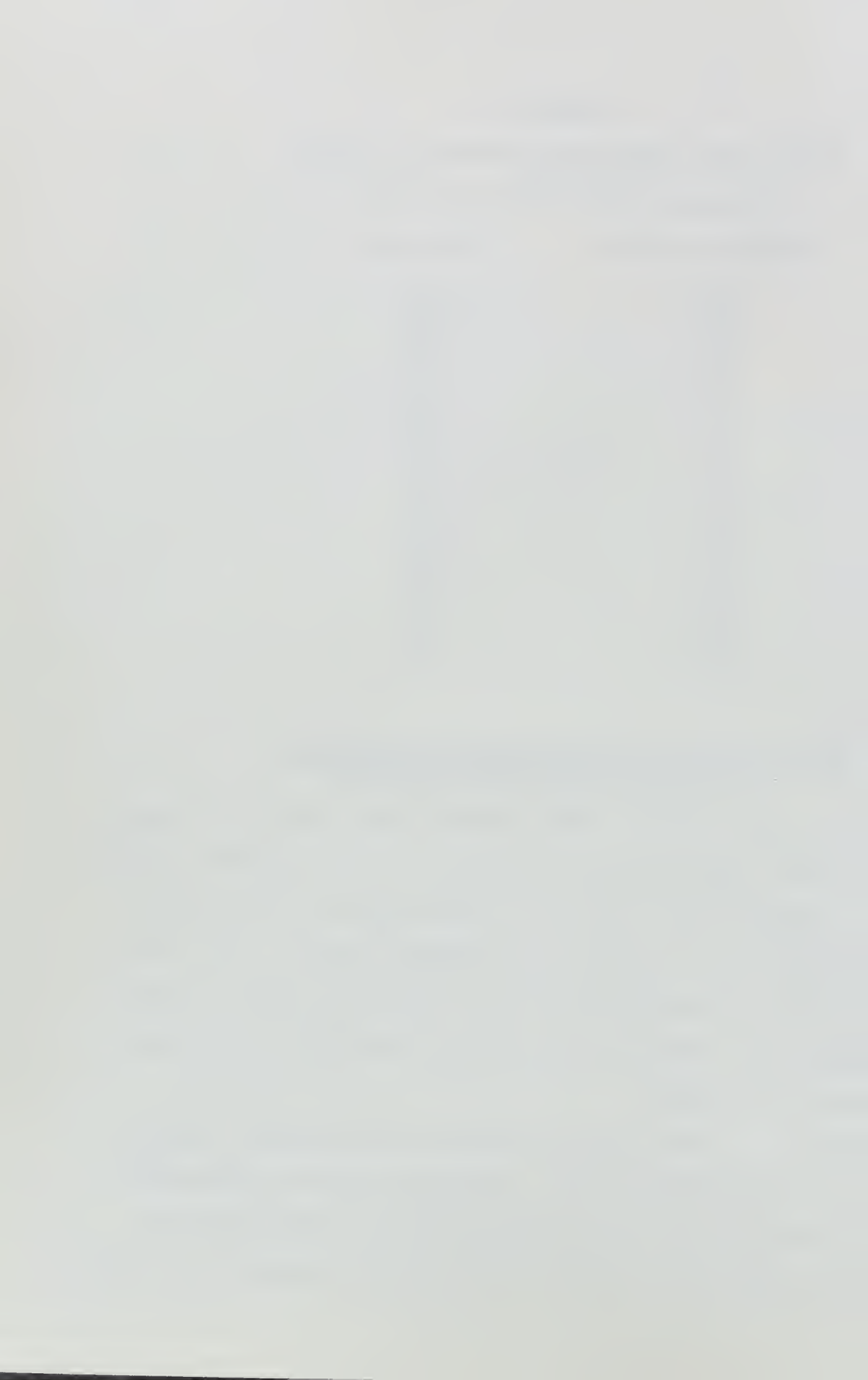
Table 1
First Month First Grade Percentile Norms
for the
Roughness Discrimination Test

| Percentile Rank | Raw Score |
|-----------------|-----------|
| 99..... | 63 |
| 95..... | 59 |
| 90..... | 56 |
| 85..... | 53 |
| 80..... | 51 |
| 75..... | 49 |
| 70..... | 46 |
| 65..... | 44 |
| 60..... | 41 |
| 55..... | 37 |
| 50..... | 34 |
| 45..... | 31 |
| 40..... | 29 |
| 35..... | 27 |
| 30..... | 24 |
| 25..... | 21 |
| 20..... | 13 |

Early Research in Roughness Discrimination
by Primary Level Blind Students

The initial study (Nolan, 1960) explored the ability of blind children in grades kindergarten through four to discriminate degrees of roughness. Ninety-four children in these grades were required to pick the rougher of two pieces of sandpaper mounted on 27 cards. The pairs consisted of combinations of 14 different grades of sandpaper when grade size refers to the size of the abrasive particles on the surface of the paper.

No relation was found between ability to discriminate degrees of roughness and chronological age. However, ability to make such discriminations was significantly and positively associated with level of grade assignment. Growth in this ability appeared to level



off after grade three. Up to this point, as children accumulated more grade experience, they were able to make finer and finer tactual discriminations. This was verified by retest scores of children after an interval of one year which showed significant improvement over the preceding year.

A subsequent exploratory study (Nolan & Morris, 1960), using a more complex discrimination task, replicated the major findings of the first study. In addition, correlations between discrimination scores and IQ were found to be moderate.

The results of these studies, particularly those revealing the growth of tactual ability, stimulated interest in study of the relationship between tactual ability and the ability to learn to read braille. The next step was formal development of an instrument to measure tactual discrimination.

Development of the Roughness Discrimination Test

The first version of the RDT contained 75 items. The items consisted of 3.5" x 12.5" cards upon which were mounted four pieces of sandpaper 2 in. square. Three squares of sandpaper were of equal grit size while the fourth was of a larger grit size. The task for the subject was to feel the four squares and identify the square that felt rougher or different from the other three. Increasing the stimuli per item from two in the previous versions of the task to four reduced the effects of guessing upon test scores and increased the range of variability possible among subjects.

The 18 grit sizes used ranged from 24-600 (See Appendix A). On no item were grit sizes compared that were more than five grades

apart (Roach, 1957). The serial order of the various combinations as well as the position of the rougher square within items were randomized using a table of random numbers.

One hundred forty children took this form of the test during the period October 1960 - February 1961. These children were all braille readers or potential braille readers enrolled in the Ohio and Kentucky residential schools for the blind. This group is described in Table 2.

Table 2
Item Analysis Group

| <u>Grade</u> | <u>Girls</u> | <u>Boys</u> | <u>Age Range (Mos.)</u> |
|--------------|--------------|-------------|-------------------------|
| Kindergarten | 7 | 10 | 71-108 |
| First | 12 | 17 | 73-106 |
| Second | 13 | 19 | 83-129 |
| Third | 21 | 22 | 95-144 |
| Fourth | 11 | 8 | 105-170 |

Item difficulties and item-test correlations were computed. Items having difficulty indices falling outside the range .10-.85 were eliminated from the test. Items were also eliminated if the item-test correlation (phi coefficients) failed to reach significance at the 5% level of confidence. Medians and ranges for the difficulty and phi coefficient indices are given in Table 3 for the 69 items that met both criteria.

Table 3
Medians and Ranges for Item Statistics

| <u>Item Index</u> | <u>Median</u> | <u>Range</u> |
|-------------------|---------------|--------------|
| Difficulty | 35.00 | .12-.78 |
| Phi coefficient | .52 | .22-.81 |

A split-half reliability coefficient was computed for the 69 item test. When corrected by the Spearman-Brown formula this coefficient was .94. Therefore, the S.E. of measurement was 4.09.

Seventy boys and 70 girls were matched according to age in order to determine whether a difference existed between the sexes on performance on the RDT. They were divided into two groups, one being composed of students from 75-100 months of age and the other of students 101-138 months of age. Table 4 shows the means and the standard deviations for these groups.

Table 4

Means and Standard Deviations for Scores Earned
by Male and Female Students at Two Age Levels
on the Roughness Discrimination Test

| | <u>75-100 months</u> | | <u>101-138 months</u> | |
|-------|----------------------|--------|-----------------------|--------|
| | Male | Female | Male | Female |
| N | 35 | 35 | 35 | 35 |
| Means | 34.26 | 37.08 | 37.34 | 42.14 |
| SD | 11.99 | 15.51 | 15.25 | 13.97 |

Although Table 4 indicates that females performed slightly better than males at both age levels, further analysis established that this difference is not statistically significant at the 5% level. Table 5 reports this analysis of variance.

Table 5

Analysis of Roughness Discrimination Test Scores
for Males and Females at Two Age Levels

| <u>Source</u> | <u>SS</u> | <u>DF</u> | <u>MS</u> | <u>F</u> | <u>F.05</u> |
|---------------|-----------|-----------|-----------|----------|-------------|
| Sex | 509 | 1 | 509 | 2.43 | 3.93 |
| Levels | 580 | 1 | 580 | 2.77 | |
| Pairs | 1123 | | | | |
| Sex x Level | 34 | 1 | 34 | | |
| Within Groups | 28422 | 136 | 209 | | |
| Total | 29545 | 139 | | | |



Validation of the RDT

Two types of validity were determined for the RDT Predictive validity of the test for the first grade was determined by correlating RDT scores obtained during the initial two months of the first year of school with reading criteria obtained during the final two months of the same school year. Concurrent validity for the second grade was determined by correlating RDT scores and reading criteria obtained at the same sitting during the first two months of the second year of school

The reading criteria were reading error and reading time scores derived from a braille adaption of the Gilmore Oral Reading Test, Form A Paragraphs 1, 2 and 3 of this test were reproduced in double spaced braille for first grade students, and single spaced braille for second grade students. These were administered and scored as described in the test manual except that no pictures were used and the scoring categories "Disregard of Punctuation" and "Hesitations" were omitted and a category for "Missed Place" added

Validation Group The first grade group consisted of 156 students from residential schools for the blind in Alabama, Georgia, Illinois, Indiana, Kentucky, Missouri, North Carolina, Ohio, Pennsylvania (Overbrook), Tennessee, and Virginia. Because of their close resemblance to other pupils in the sample, 19 kindergarten pupils from North Carolina were also included in the group giving a total of 175 students in this group. However, due to an error in procedure, the time scores of 25 pupils could not be included in the validation analysis.

The second grade group included 81 pupils from the Indiana, North Carolina, Overbrook, and Tennessee schools for the blind. Descriptive statistics for these groups appear in Table 6.

Table 6

Descriptive Statistics for Validation Groups

| <u>Grade</u> | <u>N</u> | <u>Boys</u> | <u>Girls</u> | <u>Age Range (Mos.)</u> |
|--------------|----------|-------------|--------------|-------------------------|
| First | 175 | 97 | 78 | 72-148 |
| Second | 81 | 36 | 45 | 85-138 |

It should be noted that the groups above do not represent random samples of blind pupils in their grades. However, the first grade group includes approximately 22% of all braille first graders in residential schools during the period 1961-1962 and 16% of all braille first graders in both public and residential schools at this period. The second grade group includes 14% of all second grade braille pupils enrolled in residential schools during this same period.

Predictive Validity for Grade One. How well do RDT scores obtained for first grade pupils at the start of the year predict the degree with which they will be able to read at the end of the year? The data demonstrates that the test does this quite well. Median scores and ranges for the RDT and the reading criteria appear in Table 7. In computing these, any pupil unable to complete the RDT or reading test was given a score slightly inferior to the poorest score achieved in the group.

Table 7
Descriptive Data for Grade One

| <u>Score</u> | <u>Range</u> | <u>Median</u> | <u>N</u> |
|---------------------|--------------|---------------|----------|
| RDT (items correct) | 10-63 | 34.0 | 175 |
| Reading Errors | 1-150 | 36.0 | 175 |
| Reading Time (min.) | 1.8-25.0 | 7.4 | 150 |

The Pearson product-moment correlation between RDT scores and reading errors was found to be $-.53$ and the correlation between RDT scores and reading times was $-.57$. Evidence for validity becomes quite clear when scores of pupils are categorized according to whether they fall above or below the respective medians for the variables involved. These data are presented in Table 8. They indicate that a prediction on the basis of RDT score made at the start of the school year of whether a pupil would fall in the upper or lower half of the distribution of his group for reading errors would be correct 70% of the time. A similar prediction for reading time would be correct 75% of the time.

Table 8
Contingency Tables for Data Grouped
According to Median Splits on all Variables

| RDT Score | <u>Reading Errors</u> | | <u>Reading Time</u> | |
|---------------|-----------------------|------------------|---------------------|------------------|
| | Superior Half | Inferior Half | Superior Half | Inferior Half |
| Superior Half | 61 | 27 | 56 | 19 |
| Inferior Half | 25 | 62 | 19 | 56 |

A limited amount of data indicates the possibility of combining IQ scores and RDT scores in prediction of reading success in grade one. Data on IQ scores were available for 58 pupils in the validation

group. Medians and ranges for the several variables describing this group appear in Table 9.

Table 9

Descriptive Statistics for a Sub-group
upon which IQ Scores Were Available

| | <u>Median</u> | <u>Range</u> | <u>N</u> |
|---------------------|---------------|--------------|----------|
| RDT (items correct) | 43.5 | 10-63 | 58 |
| IQ | 85.5 | 37-130 | 58 |
| Reading Errors | 22.2 | 1-150 | 58 |
| Reading Time (min,) | 4.2 | 2.1-25.0 | 58 |

Table 10 gives the correlations between the various variables and also the multiple correlation obtained when both IQ and RDT scores are used to predict the criteria.

Table 10

Correlation Matrix for Computation of Multiple Correlation
between RDT, IQ, and Reading Criteria

| | <u>IQ</u> | <u>Reading Errors</u> | <u>Reading Time</u> |
|---------------------|-----------|-----------------------|---------------------|
| RDT | .31 | -.42 | -.42 |
| IQ | | -.41 | -.36 |
| Criterion x RDT, IQ | | .51 | .48 |

Inspection of this table shows that prediction using both variables yields a higher relationship with the criteria than when either RDT or IQ alone are used as predictors.

Concurrent Validity for Grade Two. The relationship between RDT scores and reading criteria obtained at the beginning of the second year of school was determined in order to further evaluate the RDT. Table 11 gives the medians and ranges for data on each variable.

Table 11

Descriptive Data for Grade Two

| <u>Variable</u> | <u>Range</u> | <u>Median</u> | <u>N</u> |
|---------------------|--------------|---------------|----------|
| RDT (items correct) | 10-62 | 43.0 | 81 |
| Reading Errors | 1-150 | 24.0 | 81 |
| Reading Time (min.) | 1.1-25.0 | 5.9 | 81 |

The correlation between RDT scores and reading errors was $-.24$ and the correlation between RDT scores and reading times was $-.26$. Both these coefficients are significantly different from zero at the 5% level of confidence. Therefore, definite but small relationships do exist between RDT scores and the criteria for reading ability of second grade students.

Use of Test Results

In order to learn to read braille, it is necessary to be able to make precise tactual discriminations. The RDT is a test designed to measure the ability of beginning first grade children to make such discriminations. Validation of the test, with groups of first grade children as subjects, has shown that children who do well on the RDT at the start of the first grade will tend to be successful in learning to read braille while those who do poorly are likely to be unsuccessful. The test was not designed for use with older children or adults.

It is suggested that the RDT be administered to first grade children during the first two weeks of the school year. The results of the test can then be used to divide the class into reading groups according to potential. A possible division of a class into three reading groups is suggested by the data included in Table 12.

Table 12

Per Cent of Students in Superior and Inferior Half of Normative Group on Two Criteria of Reading as Grouped according to Three Levels of Performance on the RDT

| RDT Score | Reading Errors | | Reading Time | |
|----------------|----------------|---------------|---------------|---------------|
| | Superior Half | Inferior Half | Superior Half | Inferior Half |
| 40-69 | 73.0% | 27.0% | 76.7% | 23.3% |
| 30-39 | 53.6% | 46.4% | 50.0% | 50.0% |
| Untestable -29 | 27.4% | 72.6% | 25.0% | 75.0% |

As indicated by Table 12, students obtaining RDT scores within the range 40-69 achieve reading performance in the upper half of their classes 73% of the time. Children obtaining these scores are good potential readers and should profit by the regular instructional program.

Students falling within the range 30-39 have about an even chance of falling within the upper half or lower half of their class in reading achievement. Such children should be closely observed as reading instruction continues so that levels of instruction may be modified as their progress indicates.

Children who are untestable or who obtain a score of 29 or less have the least potential for learning to read. Most of these children will benefit from a strong reading readiness program. Particular attention should be given to those students who were unable to complete the test. Inability to participate in this simple task could be a danger signal for the presence of behavioral disorder.

As additional information becomes available for each child, modification of the initial grouping may be desirable. For example, if a child scores within the 40-69 range on the RDT, but is found to have an MA of 5.0, in all likelihood his reading potential will be poor.

His assignment to a reading group would therefore be revised on the basis of this additional information.

Table 13

Number and Per Cent of Students in Superior and Inferior Half of Normative Group on Two Criteria of Reading grouped according to Level of Performance on the RDT

| RDT Score | Reading Errors | | | |
|------------|----------------|------|---------------|------|
| | Superior Half | | Inferior Half | |
| | N | % | N | % |
| 60-69 | 7 | 77.8 | 2 | 22.2 |
| 50-59 | 25 | 80.6 | 6 | 19.4 |
| 40-49 | 22 | 64.7 | 12 | 35.3 |
| 30-39 | 15 | 53.6 | 13 | 46.4 |
| 20-29 | 9 | 27.3 | 24 | 72.7 |
| 12-19 | 3 | 50.0 | 3 | 50.0 |
| Untestable | 8 | 23.5 | 26 | 76.5 |

| RDT Score | Reading Time | | | |
|------------|---------------|------|---------------|------|
| | Superior Half | | Inferior Half | |
| | N | % | N | % |
| 60-69 | 6 | 75.0 | 2 | 25.0 |
| 50-59 | 20 | 76.9 | 6 | 23.1 |
| 40-49 | 20 | 76.9 | 6 | 23.1 |
| 30-39 | 11 | 50.0 | 11 | 50.0 |
| 20-29 | 9 | 28.1 | 23 | 71.9 |
| 12-19 | 2 | 33.3 | 4 | 66.7 |
| Untestable | 6 | 20.0 | 24 | 80.0 |

In some cases, teachers may require a more detailed breakdown of the relation of RDT scores and reading achievement. This is provided in Table 13.

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